

TRC

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STATEWIDE EMISSION INVENTORY
OF VERMONT

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STATEWIDE EMISSION INVENTORY
OF VERMONT

EPA Contract 68-02-0047
Task Order No. 2

Performed for Region I
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16. Abstracts The approach and the results of the work performed for the State-wide Emission Inventory for Vermont, are presented. The report details the collection, processing and reporting of emission source data for five air pollutants; sulfur oxide, particulates, nitrogen oxide, hydrocarbons, and carbon monoxide emissions. The purpose of the project was to provide the State of Vermont with input information for the preparation of Implementation Plans. The work was initiated with the mailing of Questionnaires to commercial and industrial establishments, hospitals, fuel dealers and schools. A master list was compiled of the significant source mailings, on an after-the-fact basis.			
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TABLE OF CONTENTS

<u>Section</u>	<u>Title</u>	<u>Page</u>
1.0	INTRODUCTION	1
2.0	DESCRIPTION OF THE AREA	3
3.0	DATA COLLECTION	7
3.1	Methodology	8
3.2	Area Source Emissions	10
3.3	Description of Point Source Data Form	20
3.4	Data Summaries	24
4.0	GRID MAPS	42
	Work Sheets following Page 42	
APPENDIX	Grid Maps for Vermont	

1.0 INTRODUCTION

This report documents the approach and the results of the work performed for the State-wide Emission Inventory for Vermont, Environmental Protection Agency, Contract 68-02-0047, Task Order Number 2.

The objective of the project was to support the State of Vermont Industrial Hygiene Division in the collection, processing and reporting of emission source data for five air pollutants -- sulfur oxide, particulates, nitrogen oxides, hydrocarbons, and carbon monoxide emissions.

The purpose of the project is to provide the State of Vermont with input information for the preparation of Implementation Plans, as called for under the Clean Air Act of 1970, and with data useful for the enforcement activities of the Industrial Hygiene Division.

The project began on April 6, 1971, and ended September 30, 1971. The work began after Vermont had initiated mailings of questionnaires to commercial and industrial establishments. Additional mailings to hospitals, fuel dealers and schools were prepared and delivered to Vermont under the project work.

As returns came in, a master list was compiled of the significant source mailings, on an after-the-fact basis. A compilation of the survey questionnaires appears in Table 1-1.

Information was obtained from publications and personal correspondence listed in Table 1-2.

In addition to the questionnaires, other sources of information and data were sought out. The procedure followed closely that of Bierbaum¹. The returns from the mailings totaled 686. There were about 340 follow-ups performed.

Table 1-1 Emissions Survey

Total Number of Questionnaires Mailed	1,058
Total Number sent to Manufacturers	578
Total Number sent to Municipalities	173
Total Number sent to School Districts	52
Total Number sent to Colleges & Private Academies	42
Total Number sent to Hospitals & Nursing Homes	97
Total Number sent to Fuel Dealers	97
Total Number sent to Batch Plants	19

Table 1-2 Information Sources

Bituminous Coal and Lignite Distribution for 1970
 Bureau of Mines, Sales of Fuel Oil and Kerosine in 1969
 Steam Electric Plant Factors 1970 Edition
 Mr. Raymond Centybear, Tax Department, Vermont
 Mr. Robert Lynch, National Oil Fuel Institute, New York
 Mr. Robert J. Nicholls, Highway Department, Vermont
 Mr. L. J. Gaissert, Gas Company, Burlington, Vermont
 1960 and 1970 United States Census Housing
 1963 United States Census of Manufacturing
 1967 United States Census of Retail Trade
 1968 Local Climatological Data Summary

¹
 Bierbaum, P. J., Gedgaudas, M. J., Air Pollutant Emission Inventory
Techniques, U. S. Dept. of H.E.W., Public Health Service Draft.

2.0 DESCRIPTION OF THE AREA

Vermont is a State of 6,163,138 acres (about 9300 square miles) with a population of 444,330 persons. Current land use appears in Table 2-1.

Table 2-1 Current Land Use in Vermont

Source: Vision and Choice, Vermont's Future. The Vermont Planning Council, 1968.

<u>Land Use</u>	<u>Acres</u>	<u>% of State Area</u>
Forests, (all woodlands including woodland, state and national forest and parks)	4,085,560	66.3
Agricultural Uses (open farm land)	1,468,542	23.8
Water and Marshes	322,297	5.2
Highways	127,768	2.1
Vacant Land (mountains, rock)	67,402	1.1
Urban	48,038	0.8
All Others (railroad facilities, utilities and communications, dispersed residential, mines and quarries, military installations, public buildings, stadiums, race tracks, etc.)	43,531	0.7
Total	6,163,138	100.0

The topographic trend of the state runs from the Lake Champlain shores in the northern half of the west boundary to the Green Mountains running down the central part of the State to the Connecticut River Valley in the East. The Connecticut River, from its source in New Hampshire, has a total fall of 2200 feet on the way to Long Island Sound. The character of the State, then, is generally north-south mountains with the major valleys on the west from Lake Champlain and on the east along the Connecticut River. The highest

mountains are Mount March in the Adirondacks (New York) and Mount Washington in the White Mountains (New Hampshire). The mountains and valleys cause a tendency for the winds to have more frequent northerly or southerly components.

Present distribution of population is shown in Figure 2-1. Vermont is a year-round vacationland for many out-of-staters, which had to be taken into consideration in calculations for gasoline and solid waste.

There are two Air Quality Control Regions in Vermont. These are shown in Figure 2-2. Table 2-2 lists the counties in each region and provides some data on population, area and housing units. The political jurisdiction number is used in the emission forms to identify counties.

Table 2-2 Population Area and Housing Units
by Air Quality Control Region

<u>County</u>	<u>Population</u>	<u>Area</u> (mi ²)	<u>Housing</u> (units)	<u>Political</u> <u>Jurisdiction</u>
<u>AQCR 159</u>				
Addison	24,266	785	8,540	8
Chittenden	99,131	532	30,670	9
Franklin	31,282	659	11,420	10
Grand Isle	3,574	77	2,620	11
Rutland	52,637	929	19,555	12
<u>AQCR 221</u>				
Bennington	29,282	672	11,900	1
Caledonia	22,789	613	8,860	2
Essex	5,416	663	2,590	3
LaMoille	13,309	475	4,990	4
Orange	17,676	690	7,020	5
Orleans	20,153	715	8,040	6
Washington	47,659	708	16,260	7
Windham	33,074	743	14,520	8
Windsor	44,082	965	17,510	9



Figure 2-1: Population Distribution in Vermont. Size of circle corresponds to number of persons in 1960 census. The largest circle is for 36,000 persons, the next smaller in size is for 18,000, then 10,000, 5,000, 3,000, 2,000, 1,000, 500 and 250 for the smallest.

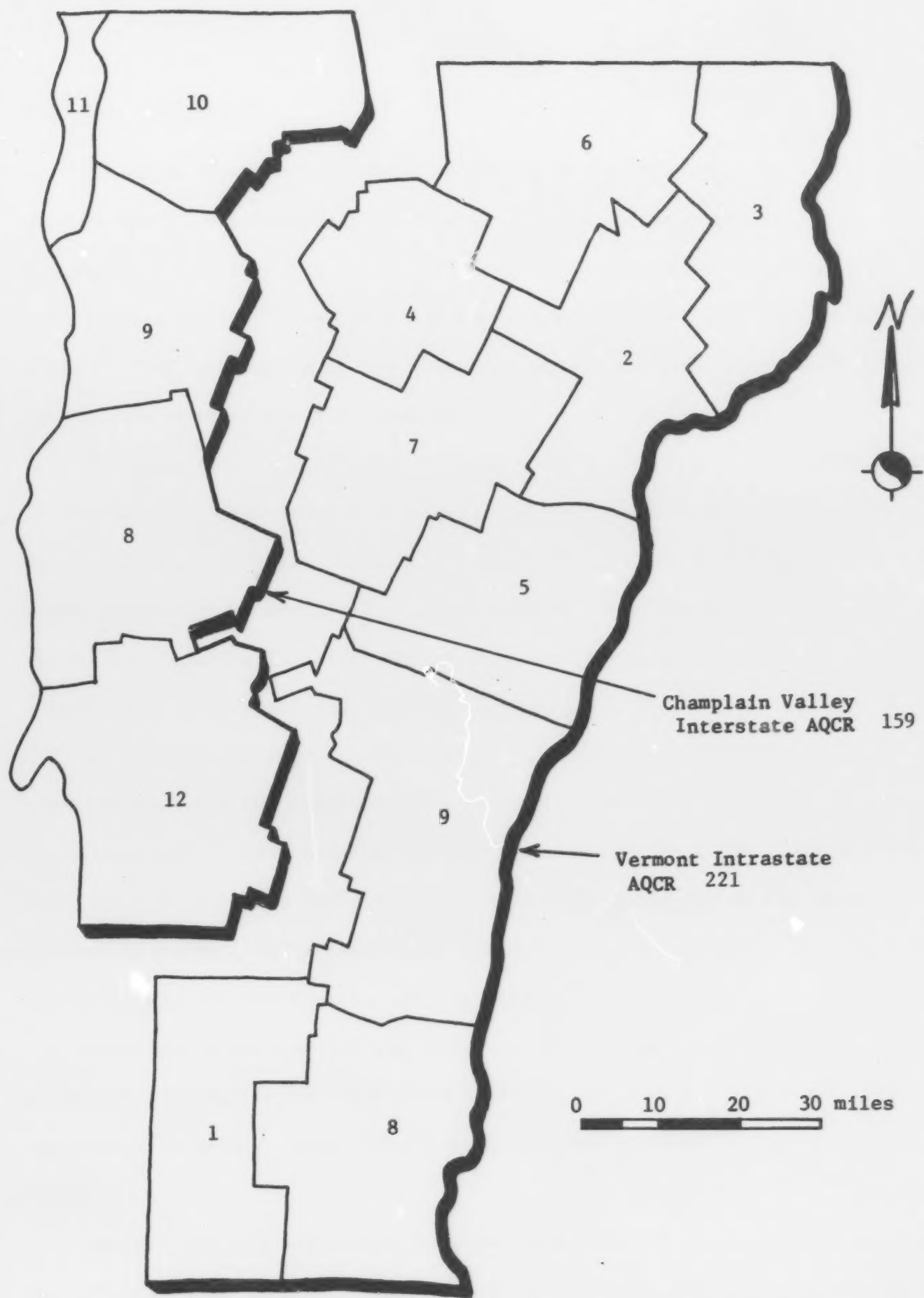


Figure 2-2: Air Quality Control Regions for Vermont
Numbers on map refer to EPA county designation.

3.0 DATA COLLECTION

Emission Inventory data were collected to provide specific information appropriate to calendar year 1970 on area and point sources for five air pollutants - particulates, sulfur oxides, carbon monoxide, hydrocarbons and nitrogen oxides. The inventory was further broken into a winter season which covered the months of November through April and a summer season which covered the months of May through October.

The inventory was conducted according to the Federal requirements listed in the April 7, 1971 Federal Register. The State of Vermont will use the inventory as part of the input information required in the Implementation Plans called for by the Clean Air Act of 1970. The inventory will also be useful for updating the files of the Industrial Hygiene Division to provide a basis for statewide enforcement activities.

As the returns came in, the Industrial Hygiene Division would make a copy and send TRC the original for processing. A master list was compiled by TRC for each county and town of all the mailings that TRC and the Industrial Hygiene Division had prepared. A copy was provided to the Industrial Hygiene Division. The returns from the mailings totaled 686. There were about 340 follow-up letters sent to non respondents.

Area source information was obtained from a number of publications and personnel correspondence previously listed in Table 1-2. The techniques outlined by Bierbaum* were closely followed when specific information was not available.

The air pollution emission inventory consists of data obtained through the questionnaires and other source material, plus estimates in those areas

*op cit.

where there is a lack of specific information. The estimates are based on generally acceptable techniques, augmented by the intimate knowledge of the state supplied by the Industrial Hygiene Division. TRC's previous and current experience with similar emission inventories was also used to prepare the following data summaries. The resulting inventory is suitable for use in the required Implementation Plans.

3.1 Methodology

The overall methodology used in the Vermont air pollution emission inventory centered on correctly apportioning various types of fuels, process emissions, and combustible solid waste. Since the data apply to 1970, solid waste emissions are included. Open burning is now prohibited by Vermont regulations. Totals for all types of fuels, process emissions and solid waste were determined from the tabulated sources. The fuels and solid waste were apportioned according to population and applicable land use variables in each region. No estimate was made for area source process emissions. Once sub-totals had been established for fuels and solid waste for regions 159 and 221, the quantities reported by "point source" questionnaires were subtracted to determine the quantities of fuel that would be available for area source apportioning.

For Vermont, a point source was defined as one that had fuel burning operations that emitted over 10 tons/year of any one of the five pollutants or was in one of the special SIC categories (SIC 2000, 2200, 2600, 2800, 2900, 3200, 3300, 3400). Fuel burning operations that consumed 139 tons/year of 9.0% ash, 2.0% S coal; 63,694 gallons/year of 2.0% S residual oil; 469,483 gallons/year of .3% S distillate oil; or $266 \times 10^6 \text{ ft}^3$ of normal natural gas would produce, respectively, 10 tons per year of particulate (coal), sulfur

oxides (residual oil), sulfur oxides (distillate oil) and nitrogen oxides (natural gas). This limit of 10 tons pollutant per year was relaxed in a number of cases to include sources that emitted less than 10 tons per year, in order to effect a balance between point and area sources. This was due to the preponderance of small sources in Vermont, where even a 10 ton threshold excludes too many.

All area and point source information was either collected or broken down to a county or political jurisdiction basis. In four areas in Vermont, certain towns were further broken into "grid squares". The "grid squares" in a county reflect the typical New England congregation of residential and industrial sources. These grids indicated the greater emission density that could lead to high atmospheric concentrations over a localized area.

In order to obtain a yearly plus two seasons breakout for the Vermont Inventory, a number of assumptions and decisions were made.

The Vermont questionnaires asked for a fuel breakout by the month. There was some confusion by a number of sources in reporting fuel actually used or just billed for each month. Where "point sources" indicated usage in each month, those totals were used as reported in the summer and winter tally. For "point sources" that did not correctly fill out the questionnaires, a straight proportion was assumed between fuel consumption and degree days. Process heat was distinguished from space heating and entered on the fuel tallies appropriately. Seasonal activities, such as bituminous manufacturing, were apportioned appropriately.

Since complete 1970 figures were not available for degree days, a 30 year average from about 6 different stations around Burlington was used. The average resulted with 85% of the degree days occurring within the 6 month

winter season and 15% of the degree days occurring in the 6 month summer season.

In order to apportion area sources according to seasons, page 44 of the previously cited Bierbaum's technique was consulted. There it was suggested that domestic uses consume 10% of the fuel for hot water heating purposes. Area source commercial and industrial fuel usage was assumed to be solely for space heating. These percentages and assumptions were reflected in the appropriate fuel categories under both area and point sources.

The overall concept of area source "smearing" as conducted for the Vermont inventory represented the major compromises which had to be made in the program. The concept of an emission inventory implies knowledge on at least three precepts of the reported emission: how much, where and when. The less precise any one of the three is, the less is known about the total situation. This was particularly true of petroleum products evaporation during storage and handling.

The oil evaporation category was included on the suggestion of Region I, EPA. The Air Pollution Emission Factor Book implied this was the evaporation encountered at tank farms. However, when the above emissions were smeared by population and considered on a statewide basis, the summed totals indicated on the EPA computer printouts do, in TRC's opinion, reflect the actual emissions.

3.2 Area Source Emissions

Estimation of area source emissions for the two regions in Vermont relied upon many of the techniques outlined by Bierbaum. In many cases specific information for the calendar year 1970 was not available and estimates had to be made on information already obtained by TRC.

To facilitate the explanation of the reported fuel tallies, process emissions and combusted solid waste, the discussion will focus on one fuel or category at a time with reference to EPA source Category Totals Input Sheets, Tables I, II, and III.

3.2.1 Coal

The Bituminous Coal and Lignite Distribution for 1970 listed a four state industrial and commercial total of 1,071,000 tons for Vermont, Maine, New Hampshire and Rhode Island. Eleven years of data on soft coal (Bituminous) show a general 22% decrease in coal use per year. The problem was to update previous breakouts of industrial and retail coal distribution and use the proper Vermont proportion of the four state industrial and commercial coal.

The breakout on hard coal (anthracite) showed 43% of the four state total going to Vermont. It was therefore assumed that 43% of the soft coal is sold in Vermont. A review of Table 42 of the Minerals Yearbook updated to 1970 gives 13,400 tons for retail soft coal -- that going to both commercial establishments and homes. Applying the 43% Vermont proportion, we obtain a total of 5800 tons retail soft coal.

When the anthracite coal is updated to 1970, to compensate for the yearly decrease, we find 22,000 tons of hard coal for Vermont. Of this, 44% or 9600 tons is retail. Hence the total soft and hard coal for Vermont retail is 15,400 tons, which must be divided between commercial and residential.

In 1960 there were 13,600 dwelling units using coal. The 22% decrease was applied, obtaining 1130 dwelling units using coal by 1970. A back-calculation was performed using 7870 degree days for Vermont, 5 1/2 rooms versus 5 room national average homes, and a factor of 1.2×10^{-3} per degree day ton for an average dwelling unit. This calculation provides 17,000 tons of soft and hard coal needed for Vermont dwelling units. This value subtracted from the total retail coal of 15,400 tons leaves 3,700 tons available for commercial apportionment. The apportioning was distributed throughout each county by number of commercial establishments in each county.

For industrial soft coal, there was reported in the Minerals Yearbook a total of 141,000 tons for 1968 for the four states. The 43% Vermont proportion is 86,000 tons, and updated to 1970 to account for the yearly decrease, the available soft coal is 37,000 tons. Hard coal for Vermont totals 35,800 tons for 1968. This is updated by applying the 22% per year factor, or 22,000 tons, as before. But 44% is for retail, so the 56% available for industry is 12,400 tons. We add this to the 37,000 tons of soft coal and obtain a total industrial coal usage of 49,400 tons. Reports from point sources resulted in 57,000 tons being used. The difference in these two numbers can be accounted for by assuming coal is shipped into Vermont after being sold elsewhere. However, since all the available soft and hard coal is more than accounted for by point sources, no area source industrial coal remains for apportioning.

The book "Combustion Engineering," Glenn R. Fryling M.E., was used to determine that coal shipped to Vermont was 9% ash and 2% sulfur by weight.

3.2.2 Residual and Distillate Oil

The Bureau of the Mines publication of Sales of Fuel Oil and Kerosine in 1969 provided the major input for fuel oil calculations. The Bureau of Mines tally lists 9 separate categories depicting various uses of both distillate and residual oil.

An initial estimate made by TRC was that there had been a 5% increase in all fuel oil categories except power plants. The electric company category increase reflected the recent addition of one turbine-fired peaking station.

For residential oil usage, the problem was to identify numbers of occupied dwelling units using oil burners. From census data it was determined that there were 110,732 dwelling units in 1960, and 149,101 units in 1970, an increase of 38,369. We noted above that 13,600 units used coal in 1960 and 1130 units used coal in 1970, so there were 12,470 units that converted to gas and oil. These conversions, added to the decade increase of 38,369 units means a total of 50,839 additional units are available for oil and gas usage.

The homes using gas were back calculated, providing a number of units for 1970 equal to 4,700, minus the original 1960 users of gas of 552 units, leaves about 4150 who switched to gas. Table 3-1 shows the results.

TABLE 3-1 Conversion of Heating Fuels

Units available for gas and oil	50,839
Switched to gas (minus)	-4,150
Original (1960) users of oil (plus)	<u>+85,635</u>
1970 homes using oil	132,324

With this number of oil using units, we can construct a dwelling unit fuel usage table as follows:

TABLE 3-2 Fuel Usage by Number of Dwelling Units

Oil	132,324
Gas	4,700
Coal	1,130
Wood	8,313
Bottled gas and electricity	<u>2,365</u>
Total dwelling units	149,101

The amount of oil was calculated from the number of dwelling units using oil, the BTU per average home factor, the 7,871 degree days for Vermont, and the average Vermont home rooms (5.5) ratio to the national average (5.0) to obtain 206,200,000 gallons of distillate fuel oil for dwelling units. This figure was then apportioned by oil burning homes in each county, gridded area and region.

The distillate commercial area source total was determined by adding together the Bureau of Mines Kerosine, Heating oil, Military and "Other" categories, and then subtracting the amount used under the domestic category and that reported by commercial distillate point sources.

The distillate industrial area source category was determined by adding together the Bureau of the Mines, Industrial, Oil Company and Electric categories and then subtracting the industrial distillate oil used by point sources.

The EPA categories of Railroads, Vessels and Diesel Motor Vehicles were taken directly from the Bureau of the Mines tallies. Since no point source was recorded under these categories, the total amount was entered under the area source categories.

We obtained total commercial and industrial residual oil usage from the Bureau of the Mines tally. The combined 40,000,000 gallons break out

to 27,337,000 gallons commercial and industrial point sources (as obtained from the questionnaires) and 12,705,000 gallons for commercial and industrial area sources. Total industrial fuel oil usage is 24,536,000 gallons of which about 14,930,000 gallons were for the point sources. This left a little better than 9,000,000 gallons for area industrial sources, which when subtracted from the total of 12,705,000 gallons assignable to total commercial and industrial area sources, leaves 3,000,000 gallons for commercial area sources.

Commercial, Institutional and Industrial area source emissions were apportioned by region, county and grid according to the number of non-point source establishments. From the 1967 Census Reports the total number of establishments was determined by county and in some cases by towns. From these was subtracted the total number of establishments that were considered point sources located in the appropriate counties and towns.

From fuel dealer reports it was determined that the residual oil was 2% sulfur by weight and the distillate oil was 0.3% sulfur, by weight. These figures were entered into the proper fields in the EPA computer input forms, Table II.

3.2.3 Natural and Bottled Gas

The State of Vermont has only one gas company with a pipeline that extends to Chittenden and Franklin counties. Essentially the gas company serves the needs of the greater Burlington area. However, the 1960 Bureau of the Census reports that a number of dwelling units in every county are either heated with bottled or natural gas. The gas company in Burlington indicated that 2/3 of the total gas was distributed in Chittenden County and 1/3 in

Franklin County in 1970. Industrial usage was 1,176 million cu. ft., Commercial usage 390 million cu. ft., and Domestic usage 903 million cu. ft. Industrial point sources in the Burlington area reported a total of 1,138 million cu. ft.

In addition to natural gas, there are 646 dwelling units in Region 159 using bottled gas and 1454 units in Region 221 using bottled gas. These account for 1 ton of particulates and 4 tons of nitrogen oxides for Region 159 (to be divided among five counties) and 4 1/2 tons of particulates, 4 1/2 tons of carbon monoxide and 14 1/2 tons of nitrogen oxides for Region 221 (to be divided among nine counties). While the number of homes in each county using bottled gas is known, and apportionment is made on this basis, it is felt that round off errors in the computer program relegate this category of emissions to negligible quantities.

The commercial gas was assumed to have been burned within the 2 counties with 2/3 apportioned to Chittenden County and 1/3 apportioned to Franklin County. There were no commercial point sources that reported gas usage.

The industrial area source category was assumed to be entirely within the two counties. A substantial portion of the gas was reported consumed by point sources. The remainder of the gas was apportioned 2/3 in Chittenden County and 1/3 in Franklin County for industrial area sources.

3.2.4 Domestic and "Other" Wood Burning

With no conclusive information on the quantity of wood burned in Vermont, estimates were made for domestic consumption of wood using the Bierbaum technique. The procedure involved determining the ratio of heat content of coal versus wood. This ratio was then multiplied by the "Bierbaum"

calculated number to result in a number of tons of wood. A value of 21.0×10^6 BTU per cord was found in the EPA emission factor book. A specific gravity of .8 gm/cc was used to obtain a density of 51.2 lbs/ft³. This worked out to 6.4×10^6 BTU/ton of wood, about half the value for coal. For the number of wood burning dwelling units as reported in the 1960 Census, this results in a total of 208,587 tons for domestic purposes. This tonnage was apportioned by region, county, and gridded areas.

A few of the returned questionnaires indicated some wood burning. One source burned enough to be classified as a point source under the 10 tons of pollutant per year threshold. The reported wood, plus information from the Industrial Hygiene Division provided data for area sources.

3.2.5 Open Burning and Incineration

There is no municipal incinerator in Vermont. From the report compiled by the Vermont Solid Waste Division, TRC determined that approximately 400,000 tons of solid waste were disposed of during 1970. It was assumed all of this was burned either in backyards or in local dumps. The emissions were apportioned according to population by region, county and gridded area. As noted above, open burning is prohibited beginning in 1971.

At the suggestion of the EPA Boston Regional Office the incineration category was filled by assuming that commercial sources contributed the overall emissions based on an input rate of 1.5 lbs/person/day. These emissions were apportioned by region, county and gridded area on the basis of 1970 population estimates. TRC considers these emissions to be maximum probable, because Vermont as a whole is probably not up to national averages

in terms of combustible waste.

3.2.6 Hydrocarbon Evaporation

The emissions in this category were based on EPA supplied data of 30 lbs/person/year for solvent evaporation. The population was listed by county and gridded areas, and was multiplied by 30/2000 to obtain tons per year for the entry on the EPA computer input, Table I. On Table III, population was entered by county and grid. For oil, each region total was determined to account for tank farm emissions.

3.2.7 Diesel Vessels

All the vessel traffic was assumed to be in the port of Burlington. The grid squares bordering the lake were apportioned according to apparent docking facilities.

3.2.8 Railroads

From the Bureau of Mines Report, total fuel usage by railroads was determined. Track mileage was roughly measured from the available maps. It was assumed that a quarter of all rail emissions occurred in the port areas of Burlington. In other gridded areas it was assumed that 1/2 of the county total would fall into a few certain grids, according to where tracks were indicated on Coast and Geodetic survey maps. The relative rail mileage tallies were adjusted to agree with these assumptions and were entered as the apportioning factors on Table III, one input table for the EPA computer program. Emission factors had previously been calculated and appear in the EPA Emission Factor Book and were entered on Table II.

3.2.9 Diesel Motor Vehicles

From the Bureau of the Mines tally a fuel consumption of 7,602,000

gallons was indicated for both on-highway and off-highway use. This total was apportioned by region, county and gridded area in direct proportion to gasoline motor vehicle mileage counts.

3.2.10 Gasoline Motor Vehicles and Gasoline Evaporation

The State Highway Department in Vermont was able to supply TRC a total driving mileage figure of 2,687,800,000 for the entire state, of which they estimated 95% of the driven mileage was rural and 5% was urban. The State Tax Department was able to supply TRC with total gallonage figures sold in each county and in the gridded towns. Total mileage divided by total gallonage results in an average of 12.5 miles per gallon. The Emission Factor Book suggested using 12.5 MPG to estimate vehicle miles. Table I required estimating vehicle-miles at both 25 MPH and 45 MPH. With the information available it was assumed that the 95% of the miles driven is rural and corresponds to the 45 MPH category. The 5% urban miles would correspond to the 25 MPH category. It was assumed that all the mileage driven in the gridded areas (urban) was in the 25 MPH category. From the gallonage numbers available by county and the four gridded areas, the miles driven were computed. The total number of miles driven in each category was summed by region, divided by 1000 (for input purposes) and entered on Table I. The miles driven were apportioned by dividing each county and gridded area total by the total for the region, resulting in a three digit factor which was entered on Table III under each category. Emission factors were already computed by EPA and entered in the appropriate places on Table II.

The Emission Factor Book suggested a figure of 20 lbs/1000 gallons to be used to estimate hydrocarbon emissions from gasoline handling and marketing. The emissions were apportioned according to the Tax Department's

breakout of gallonage per county and town. The numbers entered as apportioning factors were the actual number of gallons divided by 100 for input purposes. In Table II, the emission factor for HC was set up to indicate lbs/1000 gallons.

3.2.11 Additional Emissions

Under the hand-calculated portion of Chittenden County, political jurisdiction 09, the estimated emissions from Burlington Airport were listed. These emissions were based on landing and take-off cycles of the mix of planes that serves the Burlington Airport.

In counties where there are gridded areas, the county sum and the gridded sum must be added together to obtain totals for a county. The county total as listed by political jurisdiction (county identification without grid coordinates) is really the remainder of the county outside the gridded area.

3.3 Description of Point Source Data Form

CARD A

Source Number: These numbers were assigned after all questionnaires were completed. This assured that each completed form would have a unique, consecutive number.

Region Number: The number referred to the Air Quality Control Region assigned by the Federal Government in Table 8 of the Point Source Data Format Instructions. See Table 2-2 in Section 2.0 of this report.

SIC Code: A number assigned at the time the form is filled out based on general information supplied on the returned questionnaire.

Process Code: A list of process codes was provided in Table 9 of the Point Source Data Format Instructions. The numbers ranged from 00 to 90 in increments

of ten. Numbers 10 through 90 listed some type of coal combustion. Process code 00 was used for all other fuels, including distillate and residual fuel oil, natural gas and solid waste combustion. Process codes with numbers 1 through 9 in the units digit (01-09) indicated specific source characteristics as enumerated in the instructions.

Site Number: A site number was assigned to each different address.

Descriptive Name: This is either the entire name or a contraction of the name of the company or institution.

X and Y Coordinates: Vermont is in UTM grid zone 18. The coordinates were determined by locating the address on a standard highway map, which was gridded in the UTM system. Grid maps are in Appendix B.

Political Jurisdiction: A two-digit number assigned to each county within an air quality control region as listed in Table 8 of the Point Source Data Format Instructions. See Table 2-2 in Section 2.0 of this report.

Ownership: The sources were characterized as private, local government, state government, federal government and steam-electric utility.

Source Type: This further identifies the source as (1) industrial process source, (2) fuel combustion source and (3) waste emission source, which were already either partially or completely identified under process code.

Operating Time: Number of hours per year each source is in operation.

Stack Height: Indicates height of stack in feet above ground level. This information was not on Vermont questionnaire and was not entered or used in any way for this report.

Stack Diameter: Inside diameter of stack in feet at the exit. This information was not on the questionnaire and was not used.

Stack Temperature: Represents average operating conditions of stack temperature. This information was not on the questionnaire.

Stack Velocity: Average exhaust velocity at outlet. This was not determined.

Maximum Exhaust Gas Volume: The design or maximum conditions (whichever is greater) should be used in input units in actual ACFM. Information was not obtained.

Normalized Plume Rise: With essentially no information available no attempt was made to estimate this parameter.

CARD B

Maximum Process Weight: Used only when explaining industrial process emission, represents maximum design conditions. This information not specifically asked for and was rarely obtained from forms.

Normal Process Weight: Pounds per hour for actual operating practices. Includes the weights of all solid or liquid raw materials entering process.

Comments: 6 letters available for describing the process. This was rarely needed for Vermont.

Boiler Rated Capacity: Intended as design or maximum capacity for each fuel combustion source expressed in 10^6 BTU/hr.

EF: Precoded set of emissions factor numbers that pertains to a particular type of fuel burning operation. Under the respective fuel categories, yearly usage was entered.

Heat Content of Fuel: These figures were all looked up in a standard reference.
2
ence..

2

For example, Combustion Engineering, G. R. Fryling, M. E., Revised Edition, Combustion Engineering, Inc., 1966.

CARD C

Ash and sulfur content of fuels: This category allows for insertion of coal, oil and natural gas sulfur content. Also, percent by weight of ash for coal is entered.

Particulate and SO₂ Control Efficiency: This represents the combined efficiency of all control devices used on each source.

Control Device Identification: Identification codes can be found in Table 11 at the Point Source Data Format Instructions, furnished by EPA.

Comments: 8 letters or less that describe the device.

Hand Calculated Emissions: Tons per year of categories not calculated by the program (process emissions and solid waste disposal).

Allowable Emissions: Tons per year of emissions allowed for any particular source based on state regulations.

CARD D

Columns 4 through 9 report allowable federal particulate emissions from model regulations for particulates.

Columns 10 through 15 report allowable federal sulfur dioxide emissions from model regulations for sulfur dioxide.

Comments: All point source descriptions for Vermont include Code GRZ 18 which indicates that grid coordinate zone 18 covers all of Vermont point sources.

3.4 Data Summaries

The results of the work performed are shown in tables in this section, in the work sheets for the Emission Inventory Summaries, also in this section, and in the RDU computer printouts, available at EPA Region I and at the Vermont Industrial Hygiene Division.

3.4.1 Fuel Usage

The tabular data on fuel usage are presented in Table 3-3, Total Point and Area Fuel Usage. An item of interest in fuel usage is the quantity of wood used for residential heating, and one industrial point source, and some industrial area sources.

3.4.2 Emission Data

The data collected and entered on the RDU Formats were run on the EPA computer program. This program apportions and calculates area source emissions by source category. The source emissions are printed on a regional and county basis. Some categories required special hand calculating such as Burlington Airport emissions, and utility peaking turbines.

In Vermont, the only control devices reported applied to particulate emissions from point sources. In AQCR 221, point sources emit 1740 tons uncontrolled, and 163 tons controlled, for a 91% control efficiency. In AQCR 159, particulate emissions from point sources are 21913 tons uncontrolled and 4895 tons controlled, for a collection efficiency of 78%.

The two primary methods of presenting emission data are the RDU computer printouts, and the work sheets entitled Emissions Inventory Summary, on the following pages. The emission data are arranged by AQCR on an annual, winter and summer basis. The data for Vermont apply to many small sources.

TABLE 3-3 Fuel Balance for Vermont

on following two pages.

TABLE 3-3 FUEL BALANCE FOR VERMONT

Wood		Coal				Natural Gas				RR	Vessels
tons		tons				10 ⁶ CF				gal(1000)	gal(1000)
Res	Ind	Res	Com	Ind	Util	Res	Com	Ind	Util	Dsl	Dsl
49476	7795	2623	2035	500	54900	903	390	1201	0	1493	294
-0	-7795	-0	-1220	-500	-54900	-0	-0	-1201	-0	-0	-0
49476	0	2623	1815	0	0	903	390	0	0	1493	294
40076	3898	2124	1730	425	27450	731	332	720	0	747	147
-0	-3898	-0	-1037	-425	-27450	-0	-0	-720	-0	-0	-0
40076	0	2124	693	0	0	731	332	0	0	747	147
9400	3899	499	305	75	27450	172	58	481	0	746	147
-0	-3899	-0	-183	-75	-27450	-0	-0	-481	-0	-0	-0
9400	0	499	122	0	0	172	58	0	0	746	147
159111	258970	9077	1665	2086	0	0	0	0	0	1068	0
-0	-258970	-0	-44	-2086	-0	-0	-0	-0	-0	-0	-0
159111	0	9077	1621	0	0	0	0	0	0	1068	0
128880	129485	7352	1415	1751	0	0	0	0	0	534	0
-0	-129485	-0	-37	-1751	-0	-0	-0	-0	-0	-0	-0
128880	0	7352	1378	0	0	0	0	0	0	534	0
30231	129485	1725	250	335	0	0	0	0	0	534	0
-0	-129485	-0	-7	-335	-0	-0	-0	-0	-0	-0	-0
30231	0	1725	243	0	0	0	0	0	0	534	0
208587	266765	11700	3700	2586	54900	903	390	1201	0	2561	294
-0	-266765	-0	-1264	-2586	-54900	-0	-0	-1201	-0	-0	-0
208587	0	11700	2436	0	0	903	390	0	0	2561	294
168956	133383	9476	3145	2176	27450	731	332	720	0	1282	147
-0	-133383	-0	-1074	-2176	-27450	-0	-0	-720	-0	-0	-0
168956	0	9476	2071	0	0	731	332	0	0	1282	147
39631	133384	2224	555	410	27450	172	58	481	0	1282	147
-0	-133384	-0	-190	-410	-27450	-0	-0	-481	-0	-0	-0
39631	0	2224	365	0	0	172	58	0	0	1282	147

Numbers smaller than one ton per year are printed out as zero. Thus, there is a round-off error which shows up primarily for small sources. This problem is compounded on the seasonal breakout, when the emissions are divided between summer and winter. The work sheets (the Emission Inventory Summaries) have been adjusted to compensate for this round-off error, but there are still some minor errors in that occasionally the summer and winter emissions do not add up to the annual emissions.

The computer printout, on the other hand, does not have this compensation for round-off error built in. There are, therefore, many more cases in which the sum of the summer and winter emissions fail to equal the annual emissions. These occurrences are obvious, and inspection will reveal cases where the annual emission might be 2, the winter, 1, (less than 2 but greater than 1) and the summer 0 (less than one but greater than zero). Large, significant sources are not subject to round-off error greater than the error inherent in the assumptions used for the emission factor calculations, or apportionments, and thus the emission values can be used directly.

Annual emissions by county are tabulated in Tables 3-4 through 3-17. These data can be obtained directly from the computer printout. As before, there are minor round-off differences between computer totals and individual pollutant totals appearing in the tables. This difference is not significant and is well within the variations inherent in the original assumptions for determining any pollutant emission from the raw data.

TABLE 3-4

ADDISON COUNTY ANNUAL EMISSIONS (TONS)

AQCR 159 Political Jurisdiction 8

<u>Point Source Emissions</u>	<u>Particulate</u>	<u>SO₂</u>	<u>CO</u>	<u>HC</u>	<u>NO₂</u>
Commercial, Institutional and Industrial					
Coal	3	37	1	1	9
Dist. Oil	2	3	0	0	8
Resid. Oil	12	305	0	3	62
Wood	33	3	3	3	11
Process	636	25	0	21	0
Utilities					
Dist. Oil	<u>7</u>	<u>7</u>	<u>92</u>	<u>18</u>	<u>97</u>
TOTAL	693	373	96	43	125
<u>Area Sources</u>					
Commercial, Institutional and Industrial					
Coal	2	6	1	0	1
Dist. Oil	20	56	0	4	79
Resid. Oil	2	32	0	0	6
Domestic					
Coal	4	16	10	2	1
Gas	6	0	6	3	15
Dist. Oil	54	232	27	16	65
Wood	156	9	12	12	58
Railroads	2	4	4	3	5
Solvent Evaporation				364	
Motor Vehicles					
Urban	3	2	959	157	91
Suburban	62	37	12,305	2,379	2,153
Open Burning	175	11	929	328	66
Gasoline Evaporation	—	—	—	<u>127</u>	—
Total	486	405	14,253	3,395	2,454

TABLE 3-5

CHITTENDEN COUNTY ANNUAL EMISSIONS (TONS)

AQCR	Political Jurisdiction 9				
	<u>Particulate</u>	<u>SO₂</u>	<u>CO</u>	<u>HC</u>	<u>NO₂</u>
<u>Point Source Emissions</u>					
Commercial, Institutional and Industrial					
Coal	36	19	0	0	5
Dist. Oil	13	36	0	3	54
Resid. Oil	48	588	0	6	127
Nat. Gas	3	0	0	7	29
Wood	15				
Utilities					
Dist. Oil	4	1	0	1	18
Resid. Oil	7	116	0	1	27
Coal	3,273	3,338	27	8	494
Process	<u>4,035</u>	<u>29</u>	<u>0</u>	<u>0</u>	<u> </u>
Total	7,434	4,129	27	28	759
<u>Area Sources</u>					
Commercial, Institutional and Industrial					
Coal	5	22	3	1	2
Dist. Oil	67	191	1	13	269
Resid. Oil	7	97	0	1	18
Domestic					
Coal	8	35	23	5	2
Gas	3	0	3	1	8
Dist. Oil	269	1,157	132	78	323
Wood	103	7	8	8	38
Aircraft	294	49	98	147	245
Railroads	9	24	26	18	28
Vessels	4	12	11	8	12
Solvent Evaporation				1,478	
Motor Vehicles					
Urban	88	54	27903	2,253	2,645
Suburban	58	35	11654	4,582	2,039
Open Burning	714	45	3796	1,340	268
Gasoline Evaporation				280	
Total	<u>1,629</u>	<u>1,728</u>	<u>43658</u>	<u>10213</u>	<u>8,495</u>

TABLE 3-6

FRANKLIN COUNTY ANNUAL EMISSIONS (TONS)

AQCR 159 Political Jurisdiction 10

	<u>Particulate</u>	<u>SO₂</u>	<u>CO</u>	<u>HC</u>	<u>NO₂</u>
<u>Point Source Emissions</u>					
Commercial, Institutional and Industrial					
Residual Oil	22	318	0	2	58
Nat. Gas	8	0	2	13	65
Utilities					
Diesel	<u>4</u>	<u>8</u>	<u>56</u>	<u>11</u>	<u>59</u>
Total	34	360	58	26	124
<u>Area Source Emissions</u>					
Coal	2	9	1	0	1
Distillate Oil	27	52	0	5	110
Residual Oil	3	39	0	0	8
Domestic					
Coal	6	25	16	4	2
Distillate Oil	70	302	35	21	84
Wood	225	13	17	17	83
Railroads	4	10	11	8	12
Solvent Evaporation				469	
Motor Vehicles					
Urban	3	2	868	142	82
Suburban	54	33	10,797	2,085	1,888
Open Burning	225	14	1,198	423	85
Gasoline Evaporation	—	—	—	<u>146</u>	—
Total	619	499	12,905	3,320	2,355

TABLE 3-7

GRAND ISLE COUNTY ANNUAL EMISSIONS (TONS)

AQCR 159	Political Jurisdiction 11				
	<u>Particulate</u>	<u>SO₂</u>	<u>CO</u>	<u>HC</u>	<u>NO₂</u>
<u>Point Source Emissions</u>					
Commercial, Institutional and Industrial					
Residual Oil	1	11	9	0	3
<u>Area Source Emissions</u>					
Commercial, Institutional and Industrial					
Coal	0	2	0	0	0
Distillate Oil	5	13	0	1	18
Resid. Oil	0	5	0	0	1
Domestic					
Coal	0	1	1	0	0
Distillate Oil	10	9	5	3	12
Wood	36	2	3	3	13
Solvent Evaporation				54	
Motor Vehicles					
Urban	1	0	228	37	22
Suburban	17	10	3,367	650	588
Open Burning	26	2	137	48	10
Gasoline Evaporation	—	—	—	35	—
Total	95	44	3,735	831	663

TABLE 3-8

RUTLAND COUNTY ANNUAL EMISSIONS (TONS)

AQCR 159 Political Jurisdiction 12

	<u>Particulate</u>	<u>SO₂</u>	<u>CO</u>	<u>HC</u>	<u>NO₂</u>
<u>Point Source Emissions</u>					
Commercial, Institutional and Industrial					
Distillate Oil	1	5	0	0	5
Residual Oil	67	944	1	9	174
Wood	71	3	5	5	23
Utilities					
Jet Turbine	68	69	0	7	145
Process	4,510	2	312	0	0
Total	4,646	1023	313	21	324
<u>Area Source Emissions</u>					
Commercial, Institutional and Industrial					
Coal	4	18	2	1	1
Distillate Oil	57	161	1	1	226
Residual Oil	7	94	0	1	18
Domestic					
Coal	3	45	29	7	3
Distillate	134	579	69	42	161
Wood	149	8	10	10	54
Railroads	4	12	13	11	13
Solvent Evaporation				790	
Motor Vehicles					
Urban	58	34	18,085	2,970	1,713
Suburban	80	48	15,990	3,091	2,798
Open Burning	379	24	2,015	711	142
Gasoline Evaporation	—	—	—	274	—
Total	875	1023	36,214	7,919	5,129

TABLE 3-9

BENNINGTON COUNTY ANNUAL EMISSIONS (TONS)

AQCR 221		Political Jurisdiction 1				
		<u>Particulate</u>	<u>SO₂</u>	<u>CO</u>	<u>HC</u>	<u>NO₂</u>
<u>Point Source Emissions</u>						
Commercial, Institutional and Industrial						
Coal	4	2	0	0	0	0
Residual Oil	29	410	0	4	76	
Dist. Oil	0	0	0	0	1	
Wood	68	7	5	5	25	
Process	339	0	900	0	0	
Total	440	419	905	9	101	
<u>Area Source Emissions</u>						
Commercial, Institutional and Industrial						
Coal	3	10	11	3	0	
Distillate Oil	30	84	0	6	118	
Residual Oil	13	174	0	2	33	
Domestic						
Coal	4	29	37	0	1	
Distillate Oil	99	426	49	30	118	
Wood	111	6	8	8	41	
Railroads	1	4	4	3	4	
Solvent Evaporation				439		
Motor Vehicles						
Urban	4	3	1,389	228	132	
Suburban	73	44	14,617	2,826	2,558	
Open Burning	211	13	1,120	395	79	
Gasoline Evaporation				219		
Total	549	793	17,235	4,162	3,084	

TABLE 3-10

CALEDONIA COUNTY ANNUAL EMISSIONS (TONS)

AQCR 221	Political Jurisdiction 2				
	<u>Particulate</u>	<u>SO₂</u>	<u>CO</u>	<u>HC</u>	<u>NO₂</u>
<u>Point Source Emissions</u>					
Commercial, Institutional and Industrial					
Coal	0	1	1	0	0
Residual Oil	10	124	0	1	26
Dist. Oil	3	11	0	1	13
Wood	54	5	4	4	18
Process	1162	1	326	4	18
Total	1229	141	331	6	57
<u>Area Source Emissions</u>					
Commercial, Institutional and Industrial					
Coal	2	7	9	2	0
Distillate Oil	22	63	0	4	89
Residual Oil	10	141	0	1	27
Domestic					
Coal	4	29	37	0	1
Distillate Oil	62	267	31	19	74
Wood	288	16	21	21	107
Railroads	2	5	5	4	5
Solvent Evaporation				342	
Motor Vehicles					
Urban	3	2	973	160	92
Suburban	52	32	10,441	2,019	1,827
Open Burning	164	13	871	308	62
Gasoline Evaporation				156	
Total	609	575	12,388	3,036	2,284

TABLE 3-11

ESSEX COUNTY ANNUAL EMISSIONS (TONS)

AQCR 221 Political Jurisdiction 3

(No Point Source Emissions)

	<u>Particulate</u>	<u>SO₂</u>	<u>CO</u>	<u>HC</u>	<u>H₂O</u>
<u>Point Source Emissions</u>					
Commercial, Institutional and Industrial					
Wood	3,750	375	250	250	1,250
Distillate Oil	0	1	0	0	1
Residual Oil	9	120	0	1	23
Process	<u>675</u>	<u>1</u>	<u>0</u>	<u>0</u>	<u>0</u>
Total	4,434	497	250	250	1,273
Average Emission					
Domestic					
Coal	1	7	8	0	0
Distillate Oil	14	62	7	4	17
Wood	54	3	4	4	20
Railroads	1	3	3	2	4
Solvent Evaporation				81	
Motor Vehicles					
Urban	0	0	28	5	3
Suburban	14	9	2,862	553	501
Open Burning	39	2	207	73	15
Gasoline Evaporation	<u>—</u>	<u>—</u>	<u>—</u>	<u>43</u>	<u>—</u>
Commercial, Institutional and Industrial					
Coal	1	2	3	1	0
Resid.	4	13	0	1	18
Dist.	<u>3</u>	<u>42</u>	<u>0</u>	<u>0</u>	<u>8</u>
	131	143	3,122	767	586

TABLE 3-12

LAMOILLE COUNTY ANNUAL EMISSIONS (TONS)

AQCR 221

Political Jurisdiction 4

	<u>Particulate</u>	<u>SO₂</u>	<u>CO</u>	<u>HC</u>	<u>NO₂</u>
<u>Point Source Emissions</u>					
Commercial, Institutional and Industrial					
Wood	24	2	2	2	10
Distillate Oil	0	0	0	0	0
Residual Oil	2	23	0	0	4
Process	<u>149552</u>	<u>1</u>	<u>0</u>	<u>0</u>	<u>0</u>
Total	149578	26	2	2	14
<u>Area Source Emissions</u>					
Domestic					
Coal	2	13	16	0	0
Distillate Oil	38	162	19	11	45
Wood	200	11	15	15	74
Railroads	1	4	4	3	4
Solvent Evaporation				200	
Motor Vehicles					
Urban	2	1	611	100	58
Suburban	32	19	6419	1241	1123
Open Burning	96	6	509	180	36
Gasoline Evaporation				96	
Commercial, Institutional and Industrial					
Coal	1	4	5	1	0
Residual Oil	6	80	0	1	15
Distillate Oil	<u>13</u>	<u>38</u>	<u>0</u>	<u>3</u>	<u>53</u>
Total	149969	338	7598	1848	1408

TABLE 3-13

ORANGE COUNTY ANNUAL EMISSIONS (TONS)

AQCR 221 Political Jurisdiction 5

	<u>Particulate</u> <u>Cont.</u>	<u>SO₂</u>	<u>CO</u>	<u>HC</u>	<u>NO₂</u>
<u>Point Source Emissions</u>					
Commercial, Institutional and Industrial					
Wood	55	6	3	3	18
Residual Oil	<u>2</u>	<u>34</u>	<u>0</u>	<u>0</u>	<u>6</u>
Total	57	40	3	3	24
<u>Area Source Emissions</u>					
Commercial, Institutional and Industrial					
Coal	2	7	8	2	0
Distillate Oil	16	44	0	3	62
Residual Oil	6	80	0	1	15
Domestic					
Coal	2	16	20	1	1
Distillate Oil	56	241	28	17	67
Wood	322	18	24	24	119
Railroads	1	3	3	2	4
Solvent Evaporation				265	
Motor Vehicles					
Urban	3	2	834	137	79
Suburban	44	27	8817	1705	1543
Open Burning	127	8	676	239	48
Gasoline Evaporation	<u>—</u>	<u>—</u>	<u>—</u>	<u>131</u>	<u>—</u>
Total (Area Source)	579	446	10410	2527	1938

TABLE 3-14

ORLEANS COUNTY ANNUAL EMISSIONS (TONS)

AQCR 221 Political Jurisdiction 6

	<u>Particulate</u> <u>Cont.</u>	<u>SO₂</u>	<u>CO</u>	<u>HC</u>	<u>NO₂</u>
<u>Point Source Emissions</u>					
Commercial, Institutional and Industrial					
Wood	375	39	25	25	125
Residual Oil	17	67	0	2	45
Process	<u>675</u>	<u>1</u>	<u>0</u>	<u>0</u>	<u>0</u>
Total	1067	107	25	27	170
<u>Area Source Emissions</u>					
Commercial, Institutional and Industrial					
Coal	1	5	6	1	0
Distillate Oil	18	50	0	4	71
Residual Oil	7	98	0	1	19
Domestic					
Coal	5	33	41	1	1
Distillate Oil	52	225	26	16	62
Wood	249	14	18	18	92
Railroads	1	2	3	2	3
Solvent Evaporation				302	
Motor Vehicles					
Urban	2	1	556	91	53
Suburban	29	18	5878	1136	1029
Open Burning	145	9	771	272	54
Gasoline Evaporation	<u> </u>	<u> </u>	<u> </u>	<u>88</u>	<u> </u>
Total (Area Source)	509	455	7299	1932	1384

TABLE 3-15

WASHINGTON COUNTY ANNUAL EMISSIONS (TONS)

AQCR 221

Political Jurisdiction 7

	<u>Particulate</u>	<u>SO₂</u>	<u>CO</u>	<u>HC</u>	<u>NO₂</u>
	<u>Cont.</u>				
<u>Point Source Emissions</u>					
Commercial, Institutional and Industrial					
Wood	8	1	1	1	3
Distillate Oil	0	1	0	0	1
Residual Oil	32	395	0	4	83
Coal	1	0	0	0	0
Process	<u>16</u>	<u>0</u>	<u>51</u>	<u>0</u>	<u>0</u>
Total	57	397	52	5	87
<u>Area Source Emissions</u>					
Commercial, Institutional and Industrial					
Coal	5	18	23	5	1
Distillate Oil	56	160	1	11	225
Residual Oil	26	356	0	3	68
Domestic					
Coal	11	78	98	3	3
Distillate Oil	155	666	77	45	183
Wood	337	19	24	24	125
Railroads	1	6	6	5	6
Solvent Evaporation				716	
Motor Vehicles					
Urban	43	25	13257	2178	1256
Suburban	51	31	10131	1959	1773
Open Burning	343	21	1822	643	129
Gasoline Evaporation				<u>248</u>	
Total (Area Sources)	1028	1380	25439	5840	3769

TABLE 3-16

WINDHAM COUNTY ANNUAL EMISSIONS (TONS)

AQCR 221 Political Jurisdiction 8

	<u>Particulate</u> <u>Cont.</u>	<u>SO₂</u>	<u>CO</u>	<u>HC</u>	<u>NO₂</u>
<u>Point Source Emissions</u>					
Commercial, Institutional and Industrial					
Wood	35	4	3	3	12
Residual Oil	21	291	0	3	54
Distillate Oil	<u>0</u>	<u>1</u>	<u>0</u>	<u>0</u>	<u>2</u>
Total	56	296	3	6	68
<u>Area Source Emissions</u>					
Commercial, Institutional and Industrial					
Coal	4	15	19	4	1
Distillate Oil	22	63	0	4	90
Residual Oil	15	210	0	2	40
Domestic					
Coal	7	78	98	3	3
Distillate Oil	107	459	54	32	127
Wood	201	12	14	14	73
Railroads	1	6	7	6	7
Solvent Evaporation				496	
Motor Vehicles					
Urban	20	14	6724	1104	637
Suburban	74	45	14849	2871	2599
Open Burning	238	15	1256	446	89
Gasoline Evaporation	<u> </u>	<u> </u>	<u> </u>	<u>286</u>	<u> </u>
Total (Area Source)	689	917	23021	5268	3666

TABLE 3-17

WINSOR COUNTY ANNUAL EMISSIONS (TONS)

AQCR 221 Political Jurisdiction 9

	<u>Particulate</u>	<u>SO₂</u>	<u>CO</u>	<u>HC</u>	<u>NO₂</u>
	<u>Cont.</u>				
<u>Point Source Emissions</u>					
Commercial, Institutional and Industrial					
Wood	566	57	38	38	189
Residual Oil	9	108	0	1	24
Distillate Oil	4	18	0	1	17
Utilities					
Gas Turbine	35	33	0	3	69
Process	<u>371</u>	<u>0</u>	<u>158</u>	<u>35</u>	<u>0</u>
Total	985	216	196	78	299
<u>Area Source Emissions</u>					
Commercial, Institutional and Industrial					
Coal	4	15	19	4	1
Distillate Oil	41	116	1	8	163
Residual Oil	21	286	0	3	55
Domestic					
Coal	10	72	90	2	3
Distillate Oil	129	556	64	39	154
Wood	388	22	29	29	144
Railroads	2	5	6	4	6
Solvent Evaporation				661	
Motor Vehicles					
Urban	1	1	306	50	29
Suburban	16	10	3171	613	555
Open Burning	317	20	1685	595	119
Gasoline Evaporation				48	
Total (Area Source)	929	1103	5371	2056	1229

4.0 GRID MAPS

There were four gridded areas for Vermont: Burlington, Rutland, Barre-Montpelier and Brattleboro. Maps showing the grid lines are in the Appendix. The gridded areas are based on the Universal Transverse Mercator (UTM) grids. The numbers on the grid maps correspond to the source number (first column) in the area emissions printouts from the computer program. The AQCR and the grid number together identify each square.

Data Representative of Calendar Year 1970 Yearly

SOURCE CATEGORY	Tons of Pollutant/Year				NO _x	Fuel, Etc. Quantity	Units
	Part	SO ₂	CO	HC			
I. Fuel Combustion							
A. Res. Fuel-Area Source							
1. (Anthracite) Coal	26	100	118	26	4	2623	Tons
2. Distillate Oil	472	2040	236	142	567	94441	10 ³ Gal
3. Natural Gas	9	0	9	4	23	903	10 ⁶ CF
4. Wood	668	37	49	49	247	49476	Tons
5. Other							
6. Total	1175	2177	407	221	643		
B. Comm.-Inst. & Ind.							
1. (Bit.) Coal a. Area Source	18	65	9	3	5	1815	Tons
b. Pt. Source	17	62	9	3	5	1720	Tons
2. Coke - Pt. Source							
3. Dis. Oil a. Area Source	159	452	2	32	637	21223	10 ³ Gal
b. Pt. Source	18	52	0	4	74	2455	10 ³ Gal
4. Res. Oil a. Area Source	45	608	0	6	116	3875	10 ³ Gal
b. Pt. Source	176	2400	2	23	459	15284	10 ³ Gal
5. Nat. Gas a. Area Source	4	0	0	8	23	390	10 ⁶ CF
b. Pt. Source	11	0	0	24	72	1201	10 ⁶ CF
6. Proc. Gas - Pt. Source							
7. Wood a. Area Source							
b. Pt. Source	117	12	8	8	39	7795	Tons
8. Other a. Area Source							
b. Pt. Source							
9. Total	565	3651	30	111	1430		
C. Electric Plant							
1. Anthracite Coal							
2. Bituminous Coal	1185	2086	27	8	494	54900	Tons
3. Distillate Oil	65	184	1	13	259	8646	10 ³ Gal
4. Residual Oil	9	117	0	1	22	745	10 ³ Gal
5. Natural Gas							
6. Other							
7. Total	1259	2387	28	22	775		
D. Total Fuel Combustion	2999	8215	465	354	2848		
II. Process Losses							
A. Area Sources							
B. Pt. Sources	18345	57	312	42	0		
III. Solid Waste Disposal							
A. Incineration							
1. On-Site a. Area Source	203	44	290	87	87	58004	Tons
b. Pt. Source							
2. Munic., etc. - Pt. Source							

For the State of Vermont

159

Air Quality Control Region

Data Representative of Calendar Year 1970 Winter

SOURCE CATEGORY	Tons of Pollutant/Year					NO _x	Fuel, Etc. Quantity Units
	Part	SO ₂	CO	HC			
I. Fuel Combustion							
A. Res. Fuel-Area Source							
1. (Anthracite) Coal	21	76	11	3		6	2124 Tons
2. Distillate Oil	382	1652	191	115		459	76487 10 ³ Gal
3. Natural Gas	7	0	7	3		18	731 10 ⁶ CF
4. Wood	541	30	40	40		200	40076 Tons
5. Other							
6. Total	951	1758	249	158		683	
B. Comm.-Inst. & Ind.							
1. (Bit.) Coal a. Area Source	50	26	0	0		6	693 Tons
b. Pt. Source	105	56	1	0		13	1462 Tons
2. Coke - Pt. Source							
3. Dis. Oil a. Area Source	136	390	2	27		541	18039 10 ³ Gal
b. Pt. Source	13	38	0	3		54	1798 10 ³ Gal
4. Res. Oil a. Area Source	38	523	0	5		99	3292 10 ³ Gal
b. Pt. Source	139	1902	1	18		38	12118 10 ³ Gal
5. Nat. Gas a. Area Source	3	0	3	2		15	364 10 ⁶ CF
b. Pt. Source	7	0	7	3		18	720 10 ⁶ CF
6. Proc. Gas - Pt. Source							
7. Wood a. Area Source							
b. Pt. Source	58	6	4	4		19	3898 Tons
8. Other a. Area Source							
b. Pt. Source							
9. Total	394	2859	18	62		784	
C. Electric Plant							
1. Anthracite Coal							
2. Bituminous Coal	593	1043	14	4		247	27450 Tons
3. Distillate Oil	32	92	0	7		130	4323 10 ³ Gal
4. Residual Oil	4	59	0	1		11	373 10 ³ Gal
5. Natural Gas							
6. Other							
7. Total	629	1194	14	12		388	
D. Total Fuel Combustion	1974	5811	281	232		1855	
II. Process Losses							
A. Area Sources							
B. Pt. Sources	3338	1	143	11		0	
III. Solid Waste Disposal							
A. Incineration							
1. On-Site a. Area Source	102	22	145	44		44	29002 Tons
b. Pt. Source							
2. Munic., etc.- Pt. Source							

For the State of Vermont

159

Air Quality Control Region

Data Representative of Calendar Year 1970

Summer

SOURCE CATEGORY	Tons of Pollutant/Year					No. x	Fuel, Etc.	
	Part	SO ₂	CO	HC	Quantity		Units	
I. Fuel Combustion								
A. Res. Fuel-Area Source.								
1. (Anthracite) Coal	5	19	22	5	1	499	Tons	
2. Distillate Oil	90	388	45	27	108	17954	10 ³ Gal	
3. Natural Gas	0	0	0	0	2	48	10 ⁶ CF	
4. Wood	127	7	9	9	47	9400	Tons	
5. Other								
6. Total	222	414	76	117	158			
B. Comm.-Inst. & Ind.								
1. (Bit.) Coal a. Area Source	9	5	0	0	1	122	Tons	
b. Pt. Source	19	10	0	0	2	258	Tons	
2. Coke - Pt. Source								
3. Dis. Oil a. Area Source	24	68	0	5	95	3185	10 ³ Gal	
b. Pt. Source	5	14	0	1	20	657	10 ³ Gal	
4. Res. Oil a. Area Source	6	76	0	1	14	483	10 ³ Gal	
b. Pt. Source	22	304	0	3	58	1941	10 ³ Gal	
5. Nat. Gas a. Area Source	1	0	1	0	1	58	10 ⁶ CF	
b. Pt. Source	4	0	0	12	29	481	10 ⁶ CF	
6. Proc. Gas - Pt. Source								
7. Wood a. Area Source								
b. Pt. Source	58	6	4	4	19	3899	Tons	
8. Other a. Area Source								
b. Pt. Source								
9. Total	148	483	5	26	239			
C. Electric Plant								
1. Anthracite Coal								
2. Bituminous Coal	593	1043	14	4	324	27450	Tons	
3. Distillate Oil	50	679	0	6	130	4323	10 ³ Gal	
4. Residual Oil	3	8	0	1	11	372	10 ³ Gal	
5. Natural Gas								
6. Other								
7. Total	646	1730	14	11	465			
D. Total Fuel Combustion	1016	2627	95	154	862			
II. Process Losses								
A. Area Sources								
B. Pt. Sources	7635	56	142	10	0			
III. Solid Waste Disposal								
A. Incineration								
1. On-Site a. Area Source	102	22	145	44	44	29002	Tons	
b. Pt. Source								
2. Munic. etc. - Pt. Source								

C. Other		a. Area Source		b. Pt. Source															
9. Total		148		483		5		26		239									
C. Electric Plant																			
1. Anthracite Coal																			
2. Bituminous Coal		593		1043		14		4		324		27450		Tons					
3. Distillate Oil		50		679		0		6		130		4323		10 ³ Gal					
4. Residual Oil		3		8		0		1		11		372		10 ³ Gal					
5. Natural Gas																			
6. Other																			
7. Total		646		1730		14		11		465									
D. Total Fuel Combustion		1016		2627		95		154		862									
II. Process Losses																			
A. Area Sources																			
B. Pt. Sources		7635		56		142		10		0									
III. Solid Waste Disposal																			
A. Incineration																			
1. On-Site		102		22		145		44		44		29002		Tons					
b. Pt. Source																			
2. Munic., etc.- Pt. Source																			
B. Open Burning																			
1. On-Site		760		48		4038		1425		285		95000		Tons					
b. Pt. Source																			
2. Dumps																			
a. Area Source																			
b. Pt. Source																			
C. Other																			
a. Area Source																			
b. Pt. Source																			
D. Total Solid Waste Disposal		862		70		4183		1469		329		124002		Tons					
IV. Transportation - Area Source																			
A. Mot. Vehicles		211		128		51070		9174		7009		41393		10 ³ Gal					
2. Diesel		18		33		239		48		250		1468		10 ³ Gal					
B. Off-Highway Fuel Usage																			
C. Aircraft		147		25		49		74		123									
D. Railroad		9		24		26		19		28		746		10 ³ Gal					
E. Vessels		2		5		5		4		5		147		10 ³ Gal					
F. Gas. Evap. Losses		0		0		0		414		0		41393		10 ³ Gal					
G. Other (Sol. Evp.)		0		0		0		1577		0		1577		Tons					
H. Total Transportation		387		215		51389		11310		7415		685025							
V. Misc. - Area Sources																			
A. Agricultural Burning																			
B. Other																			
C. Total Misc.																			
VI. Grand Total																			
A. Area Source		1511		848		55649		12902		8013									
B. Pt. Source		8389		390		160		41		593									
C. Total		9900		1238		55809		12943		8606									

B

EMISSIONS INVENTORY SUMMARY

For the State of Vermont

221

Air Quality Control Region DData Representative of Calendar Year 1970 Yearly

SOURCE CATEGORY	Tons of Pollutant/Year					Fuel, Etc.	
	Part	SO ₂	CO	HC	NO _x	Quantity	Units
I. Fuel Combustion							
A. Res. Fuel-Area Source							
1. (Anthracite) Coal	91	345	45	14	27	9077	Tons
2. Distillate Oil	562	2427	281	169	674	112367	10 ³ Gal
3. Natural Gas							
4. Wood	2148	119	159	159	796	159111	Tons
5. Other							
6. Total	2801	2891	485	342	1497		
B. Comm.-Inst. & Ind.							
1. (Bit.) Coal a. Area Source	117	62	1	0	15	1621	Tons
b. Pt. Source	153	81	1	0	19	2130	Tons
2. Coke - Pt. Source							
3. Dis. Oil a. Area Source	222	631	3	44	889	29634	10 ³ Gal
b. Pt. Source	8	24	0	2	34	1121	10 ³ Gal
4. Res. Oil a. Area Source	24	337	0	3	64	8830	10 ³ Gal
b. Pt. Source	132	1808	1	17	345	11513	10 ³ Gal
5. Nat. Gas a. Area Source							
b. Pt. Source							
6. Proc. Gas - Pt. Source							
7. Wood a. Area Source							
b. Pt. Source							
8. Other a. Area Source	3885	388	259	259	1295	258970	Tons
b. Pt. Source							
9. Total	4541	2943	265	667	2661		
C. Electric Plant							
1. Anthracite Coal							
2. Bituminous Coal							
3. Distillate Oil							
4. Residual Oil							
5. Natural Gas							
6. Other							
7. Total							
D. Total Fuel Combustion							
II. Process Losses							
A. Area Sources							
B. Pt. Sources	152351	4	1435	35	0		
III. Solid Waste Disposal							
A. Incineration							
1. On-Site a. Area Source	224	48	320	96	96	63904	Tons
b. Pt. Source							

b. Other		a. Area Source		b. Pt. Source					
9. Total		4541	2943	265	667	2661			
C. Electric Plant									
1. Anthracite Coal									
2. Bituminous Coal									
3. Distillate Oil									
4. Residual Oil									
5. Natural Gas									
6. Other									
7. Total									
D. Total Fuel Combustion									
II. Process Losses									
A. Area Sources									
B. Pt. Sources		152351	4	1435	35	0			
III. Solid Waste Disposal									
A. Incineration									
1. On-Site		a. Area Source	224	48	320	96	96	63904	Tons
		b. Pt. Source							
2. Munic., etc.- Pt. Source									
B. Open Burning									
1. On-Site		a. Area Source	1680	105	8925	3150	630	210000	Tons
		b. Pt. Source							
2. Dumps		a. Area Source							
		b. Pt. Source							
C. Other		a. Area Source							
		b. Pt. Source							
D. Total Solid Waste Disposal		1904	153	9245	3246	726		273904	Tons
IV. Transportation - Area Source									
A. Mot. Vehicles		1. Gasoline	464	281	101861	18974	15845	131477	10 ³ Gal
		2. Diesel	58	105	758	152	793	4665	10 ³ Gal
B. Off-Highway Fuel Usage									
C. Aircraft			0	0	0	0	0		
D. Railroad			13	35	37	27	40	1068	10 ³ Gal
E. Vessels			0	0	0	0	0	0	
F. Gas. Evap. Losses			0	0	0	1315	0	131477	10 ³ Gal
G. Other (Sol. Evp.)			0	0	0	3502	0	3502	Tons
H. Total Transportation			535	421	102656	23970	16678		
V. Misc. - Area Sources									
A. Agricultural Burning									
B. Other									
C. Total Misc.									
VI. Grand Total									
A. Area Source		5603	4495	112390	27605	19869			
B. Pt. Source		156529	2305	1696	313	1693			
C. Total		162132	6800	114086	27918	21562			

B

For the State of Vermont

221

Air Quality Control Region

A

Data Representative of Calendar Year 1970 Winter

SOURCE CATEGORY	Tons of Pollutant/Year					Fuel, Etc. Quantity, Units
	Part	SO ₂	CO	HC	NO _x	
I. Fuel Combustion						
A. Res. Fuel-Area Source						
1. (Anthracite) Coal	74	279	331	37	22	7352 Tons
2. Distillate Oil	455	1966	5	137	546	91006 10 ³ Gal
3. Natural Gas						
4. Wood	1740	97	129	129	644	128880 Tons
5. Other						
6. Total	2269	2342	465	303	1212	
B. Comm.-Inst. & Ind.						
1. (Bit.) Coal a. Area Source	99	52	1	0	12	1378 Tons
b. Pt. Source	129	68	1	0	16	1788 Tons
2. Coke - Pt. Source						
3. Dis. Oil a. Area Source	189	537	3	38	756	25189 10 ³ Gal
b. Pt. Source	6	17	0	1	24	793 10 ³ Gal
4. Res. Oil a. Area Source	57	776	0	7	148	4945 10 ³ Gal
b. Pt. Source	131	1792	1	17	343	11417 10 ³ Gal
5. Nat. Gas a. Area Source						
b. Pt. Source						
6. Proc. Gas - Pt. Source						
7. Wood a. Area Source						
b. Pt. Source						
8. Other a. Area Source	1942	194	129	129	647	129485 Tons
b. Pt. Source						
9. Total	2553	3436	135	63	1946	
C. Electric Plant						
1. Anthracite Coal						
2. Bituminous Coal						
3. Distillate Oil						
4. Residual Oil						
5. Natural Gas						
6. Other						
7. Total						
D. Total Fuel Combustion						
II. Process Losses						
A. Area Sources						
B. Pt. Sources	74481	0	76	0	0	
III. Solid Waste Disposal						
A. Incineration						
1. On-Site a. Area Source	112	24	160	48	48	31952 Tons
b. Pt. Source						
2. Munic., etc.- Pt. Source						
B. Open Piles						

9. Total	2553	3436	135	63	1946	
C. Electric Plant						
1. Anthracite Coal						
2. Bituminous Coal						
3. Distillate Oil						
4. Residual Oil						
5. Natural Gas						
6. Other						
7. Total						
D. Total Fuel Combustion						
II. Process Losses						
A. Area Sources						
B. Pt. Sources	74481	0	76	0	0	
III. Solid Waste Disposal						
A. Incineration						
1. On-Site	112	24	160	48	48	Tons
a. Area Source						
b. Pt. Source						
2. Munic., etc.- Pt. Source						
B. Open Burning						
1. On-Site	840	53	4463	1575	315	Tons
a. Area Source						
b. Pt. Source						
2. Dumps						
a. Area Source						
b. Pt. Source						
C. Other						
a. Area Source						
b. Pt. Source						
D. Total Solid Waste Disposal	952	77	4623	1623	363	Tons
IV. Transportation - Area Source						
A. Mot. Vehicles	232	144	50930	9487	7923	10 ³ Gal
1. Gasoline						
2. Diesel	29	52	379	76	396	10 ³ Gal
B. Off-Highway Fuel Usage						
C. Aircraft						
D. Railroad	7	17	19	13	20	10 ³ Gal
E. Vessels						
F. Gas. Evap. Losses	0	0	0	657	0	10 ³ Gal
G. Other (Sol. Evp.)	0	0	0	1751	0	Tons
H. Total Transportation	268	213	51328	11984	8339	
V. Misc. - Area Sources						
A. Agricultural Burning						
B. Other						
C. Total Misc.						
VI. Grand Total						
A. Area Source	3834	3997	56420	13955	10830	
B. Pt. Source	76689	2071	207	147	1030	
C. Total	80523	6068	56627	14102	11860	

2

EMISSIONS INVENTORY SUMMARY

For the State of Vermont

221

Air Quality Control Region

Data Representative of Calendar Year 1970 Summer

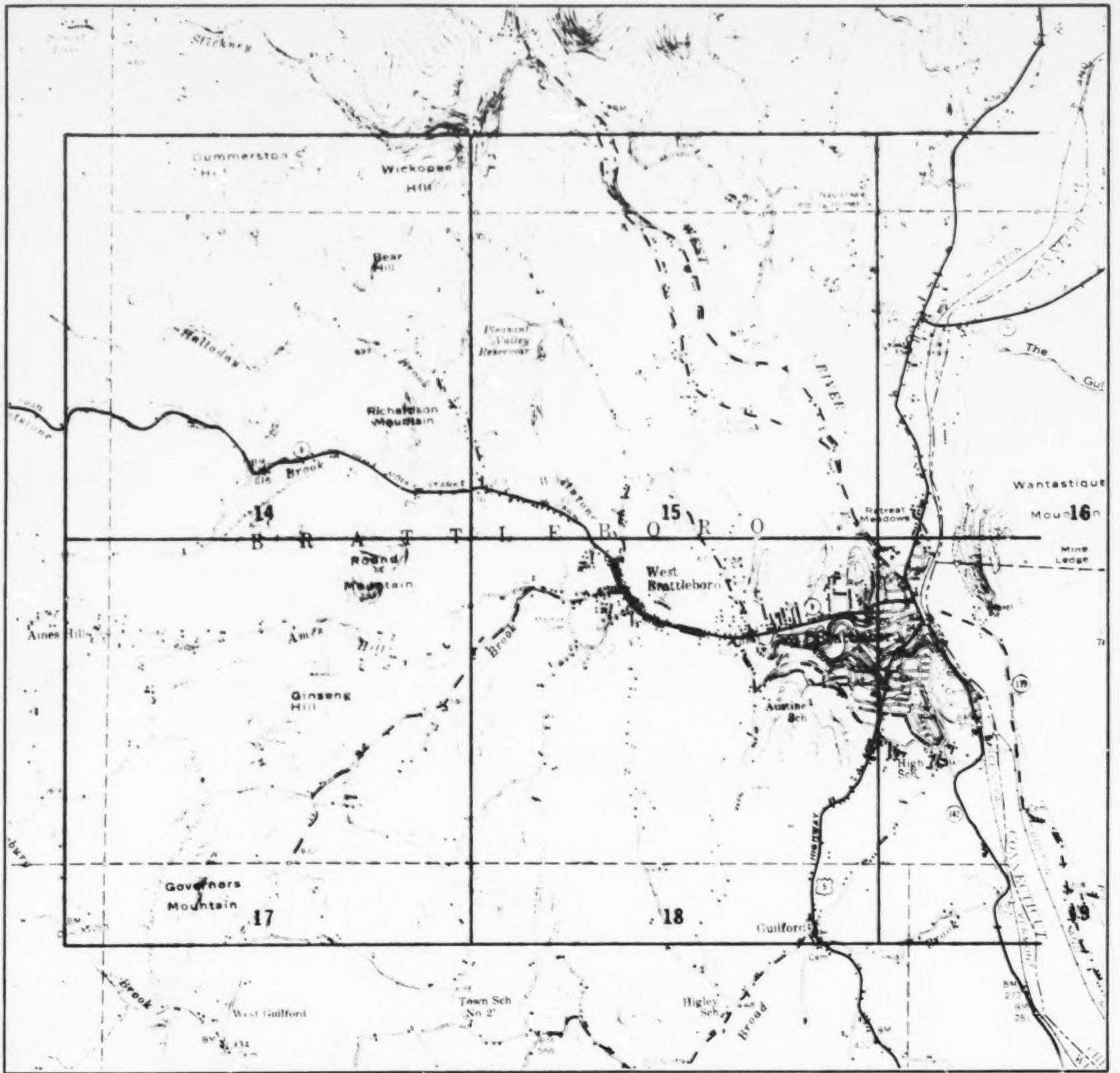
SOURCE CATEGORY	Tons of Pollutant/Year					NO _x	HC	CO	SO ₂	Part	Fuel, Etc.	
	Part	SO ₂	CO	HC	NO _x	Quantity	Units					
I. Fuel Combustion												
A. Res. Fuel-Area Source												
1. (Anthracite) Coal	17	66	9	3	5	1725	Tons					
2. Distillate Oil	160	455	2	32	641	21350	10 ³ Gal					
3. Natural Gas												
4. Wood	453	45	30	30	151	30231	Tons					
5. Other												
6. Total	630	566	41	65	862							
B. Comm.-Inst. & Ind.												
1. (Bit.) Coal a. Area Source	144	9	0	0	2	243	Tons					
b. Pt. Source	25	13	0	0	3	342	Tons					
2. Coke - Pt. Source												
3. Dis. Oil a. Area Source	34	98	0	7	137	4580	10 ³ Gal					
b. Pt. Source	2	7	0	0	10	328	10 ³ Gal					
4. Res. Oil a. Area Source	17	226	0	2	43	1439	10 ³ Gal					
b. Pt. Source	63	859	1	8	164	5470	10 ³ Gal					
5. Nat. Gas a. Area Source												
b. Pt. Source												
6. Proc. Gas - Pt. Source												
7. Wood a. Area Source	1942	194	129	129	647	129485	Tons					
b. Pt. Source												
8. Other a. Area Source												
b. Pt. Source												
9. Total	2227	1972	130	146	997							
C. Electric Plant												
1. Anthracite Coal												
2. Bituminous Coal												
3. Distillate Oil												
4. Residual Oil												
5. Natural Gas												
6. Other												
7. Total												
D. Total Fuel Combustion												
II. Process Losses												
A. Area Sources												
B. Pt. Sources	77135	3	264	17	0							
III. Solid Waste Disposal												
A. Incineration												
1. On-Site a. Area Source	112	24	160	48	48	31952	Tons					

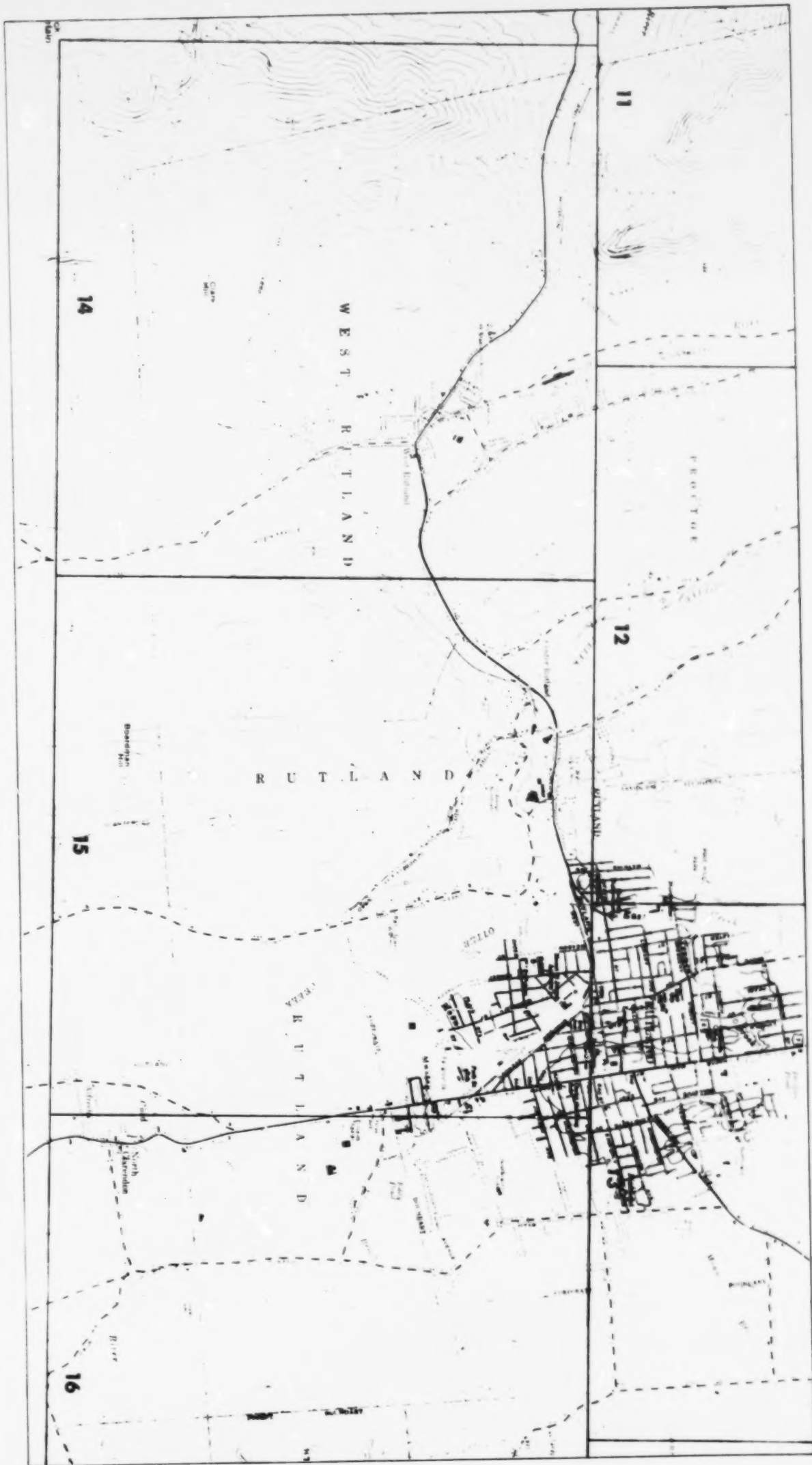
8. Other	a. Area Source								
	b. Pt. Source								
9. Total		2227	1972	130	146	997			
C. Electric Plant									
1. Anthracite Coal									
2. Bituminous Coal									
3. Distillate Oil									
4. Residual Oil									
5. Natural Gas									
6. Other									
7. Total									
D. Total Fuel Combustion									
II. Process Losses									
A. Area Sources									
B. Pt. Sources		77135	3	264	17	0			
III. Solid Waste Disposal									
A. Incineration									
1. On-Site	a. Area Source	112	24	160	48	48	31952	Tons	
	b. Pt. Source								
2. Munic., etc.- Pt. Source									
B. Open Burning									
1. On-Site	a. Area Source	840	53	4463	1575	315	105000	Tons	
	b. Pt. Source								
2. Dumps	a. Area Source								
	b. Pt. Source								
C. Other	a. Area Source								
	b. Pt. Source								
D. Total Solid Waste Disposal		952	77	4623	1623	363			
IV. Transportation - Area Source									
A. Mot. Vehicles	1. Gasoline	232	141	50930	9487	7923	65738	10 ³ Gal	
	2. Diesel	29	52	379	76	397	2333	10 ³ Gal	
B. Off-Highway Fuel Usage									
C. Aircraft									
D. Railroad		7	17	19	13	20	534	10 ³ Gal	
E. Vessels									
F. Gas. Evap. Losses		0	0	0	657	0	65738	10 ³ Gal	
G. Other (Sol. Evp.)		0	0	0	1751	0	1751	Tons	
H. Total Transportation		268	210	51328	11984	8340			
V. Misc. - Area Sources									
A. Agricultural Burning									
B. Other									
C. Total Misc.									
VI. Grand Total									
A. Area Source		2045	1186	55992	13674	9747			
B. Pt. Source		79104	302	394	154	824			
C. Total		81149	1488	56386	13828	10571			

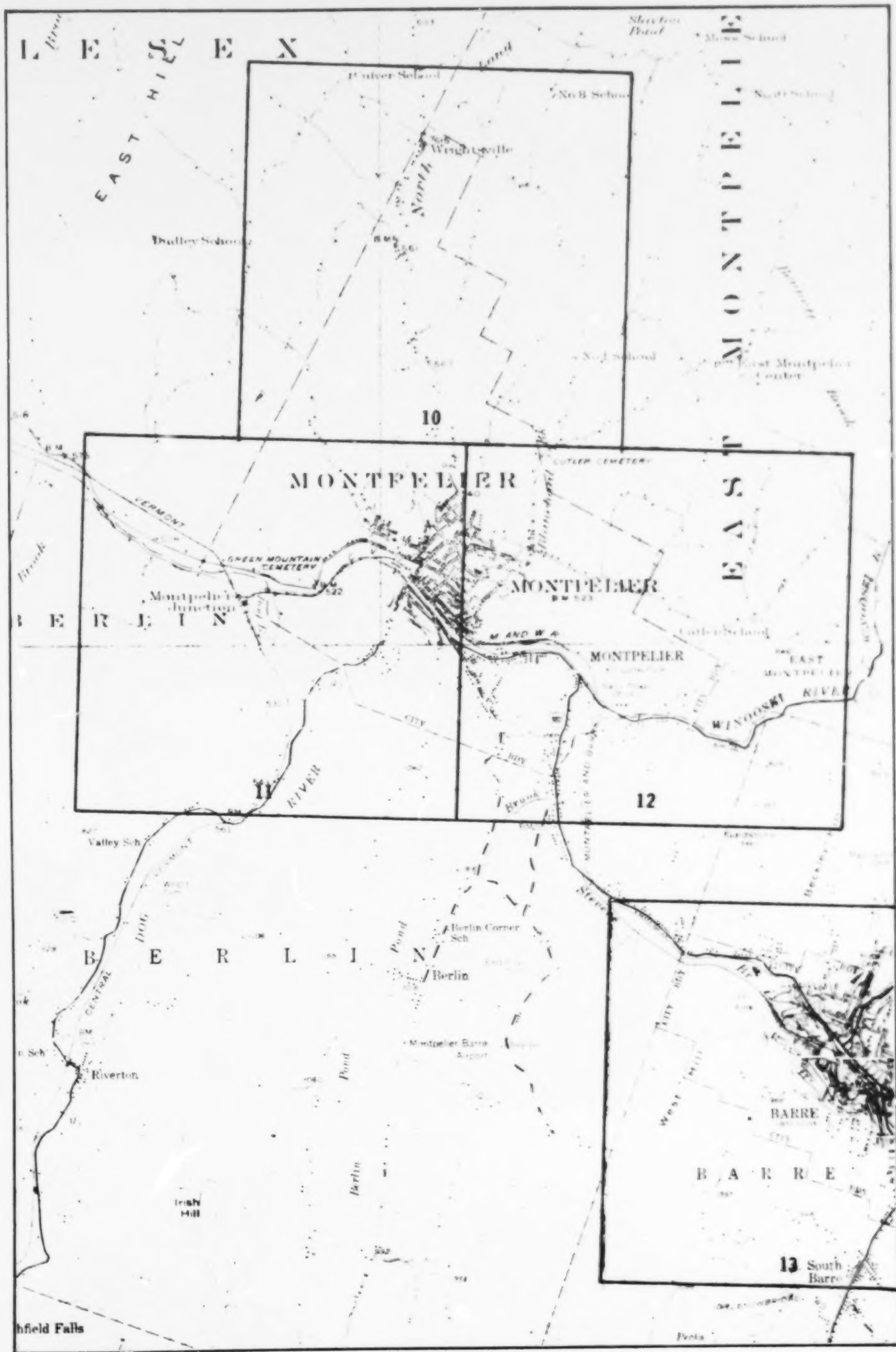
B

A P P E N D I X

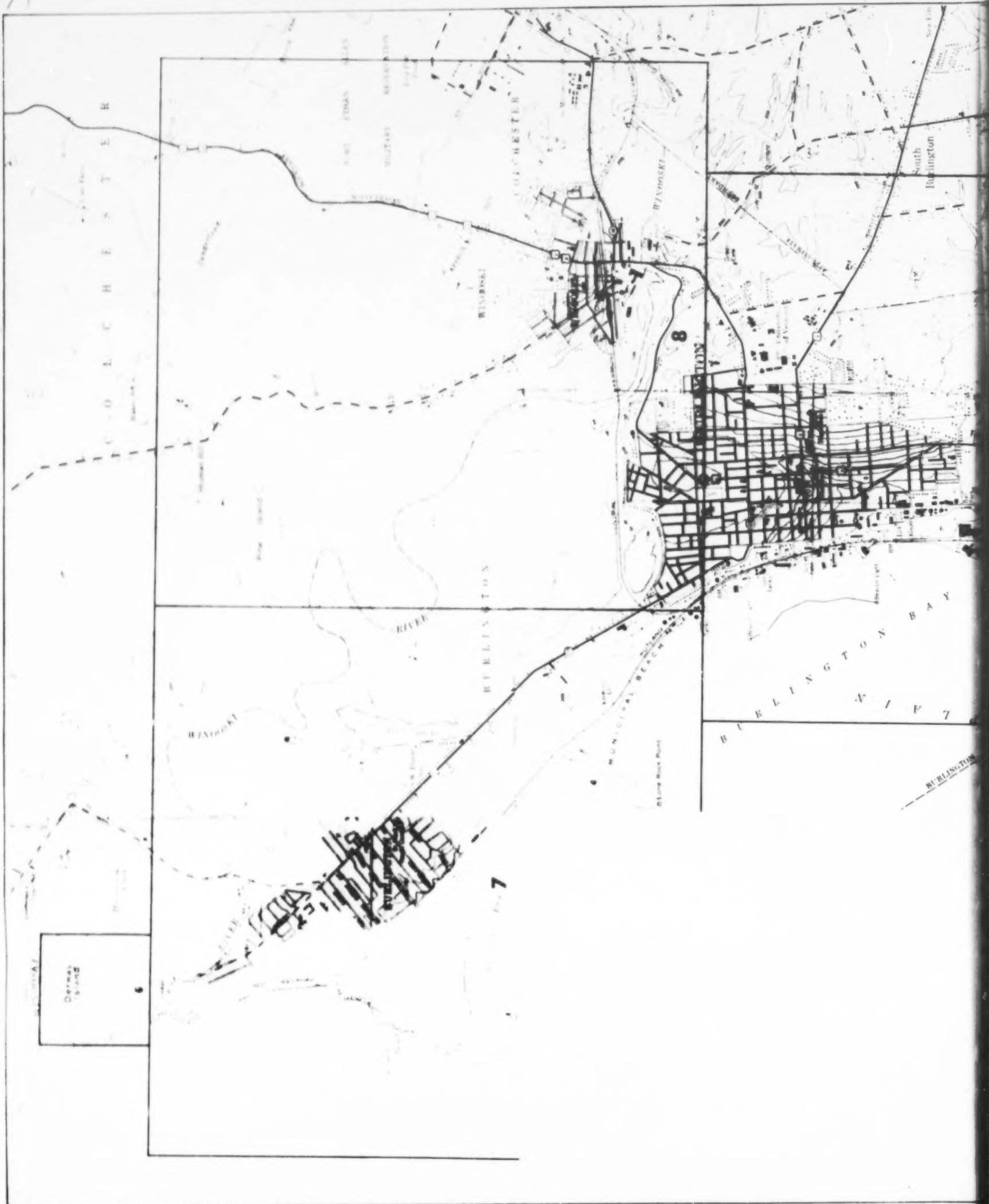
Grid Maps for Vermont







A



DATE
FILMED
11-16-71

PB 203503
(APTD- 0758)

Errata Sheet for
Statewide Emission Inventory of Vermont
EPA Contr. 68-02-0047, Task Order No. 2.

Cover Sheet: Change "Report 4283"
to "TRC-ENV-71-4283"

Page 12. 5th line from top. Change
"17,000 tons" to
"11,700 tons"

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